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(54) Abstract Title

Removable suction anchor

(57) A subsea suction anchor for anchoring in a subsea surface comprises a plurality of portions 36, 37 and 38 which are capable of transformation from a first configuration Fig 9 in which the portions are substantially adjacent to each other to a second configuration Fig 11 in which the portions are substantially spaced apart from one another, such that the anchor can be removed from the subsea surface. A method of using said anchor is also claimed. The suction anchor may have a substantially cylindrical body having a longitudinal axis, with the portions comprising discrete longitudinal lengths of the body.

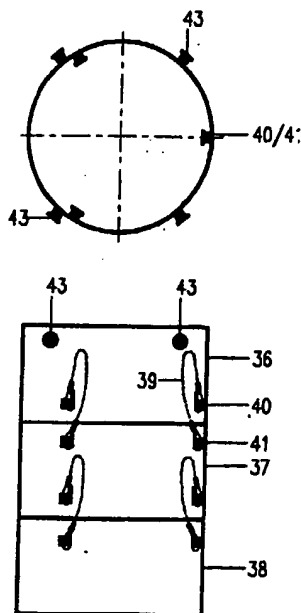


FIG 9

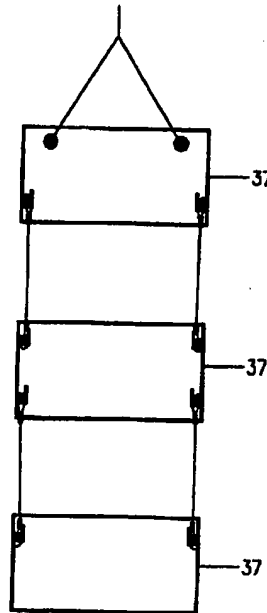


FIG 11

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0.9 33

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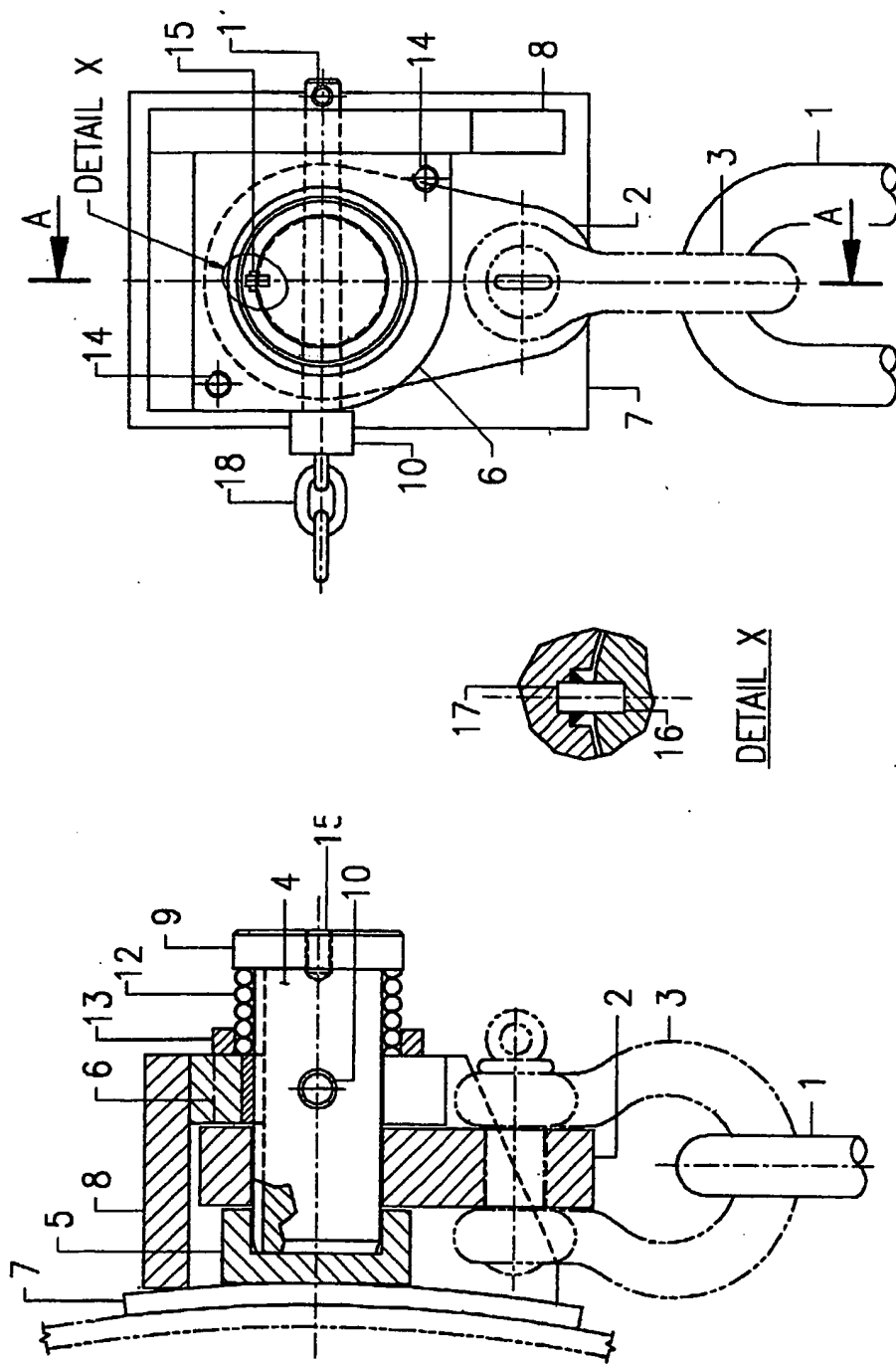


FIG 1

SECTION A-A

29
2010

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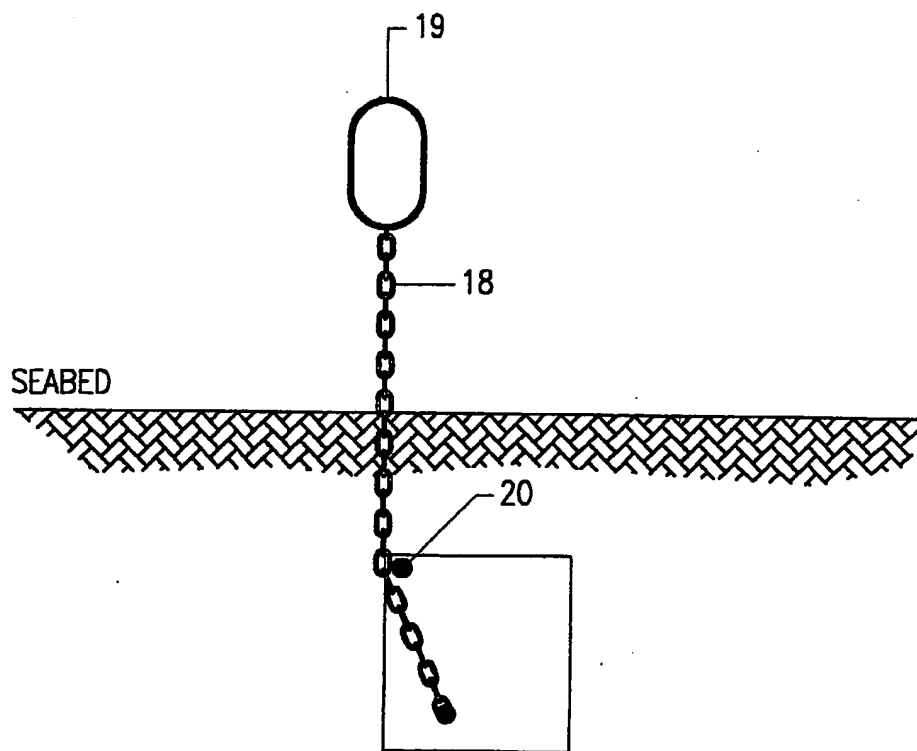


FIG 2

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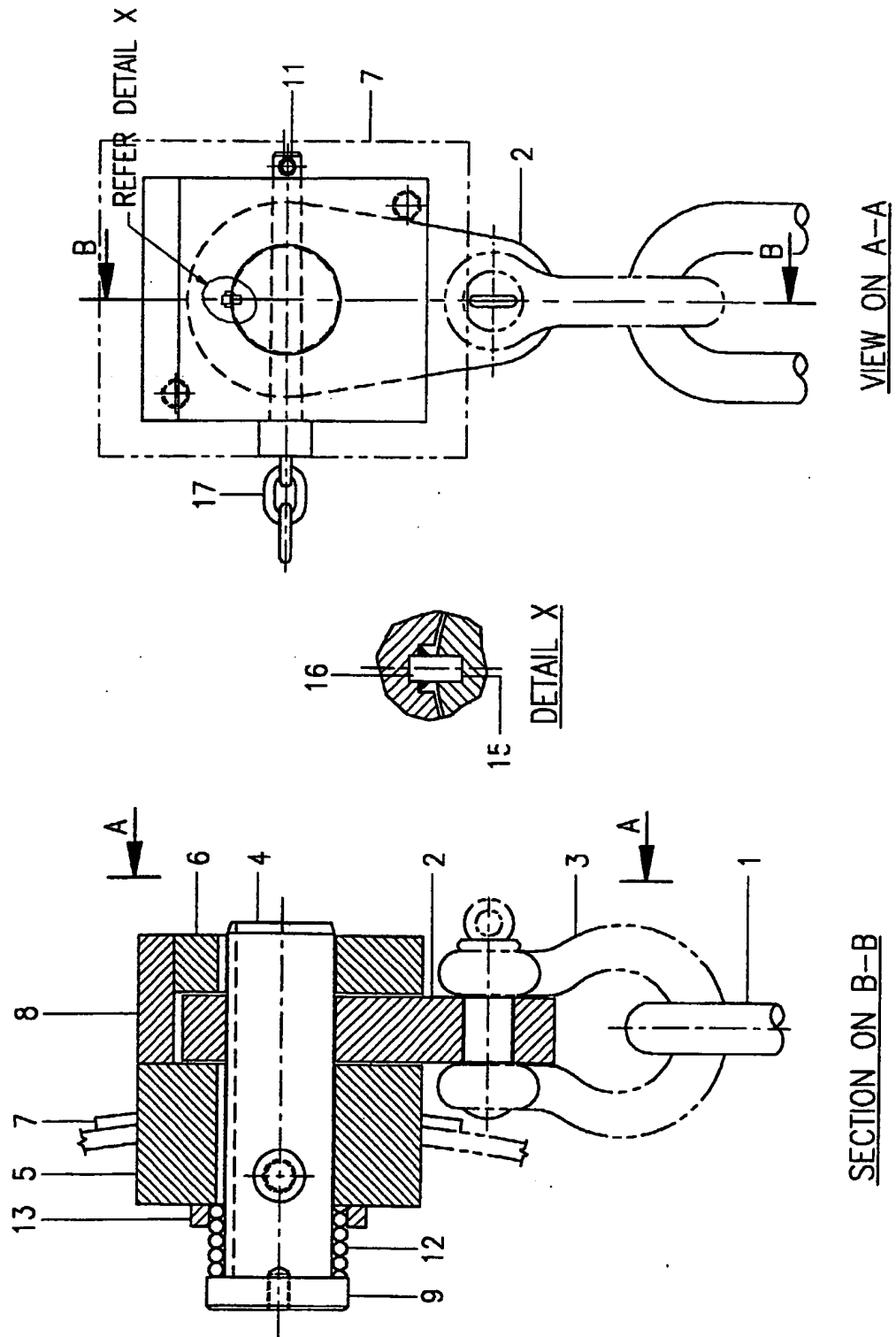


FIG 3

VIEW ON A-A

SECTION ON B-B

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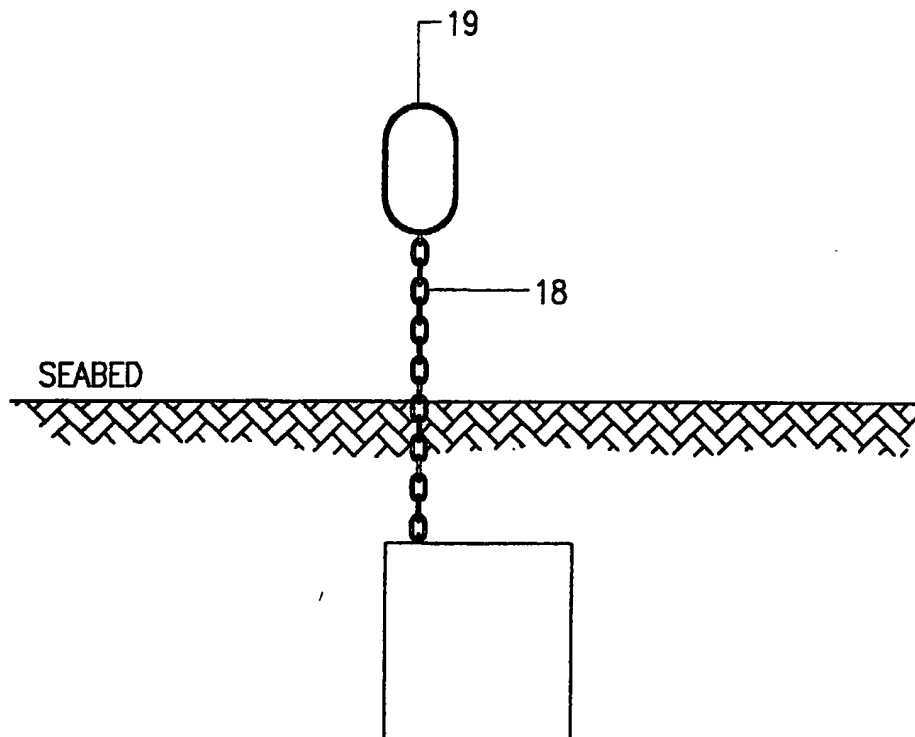


FIG 4

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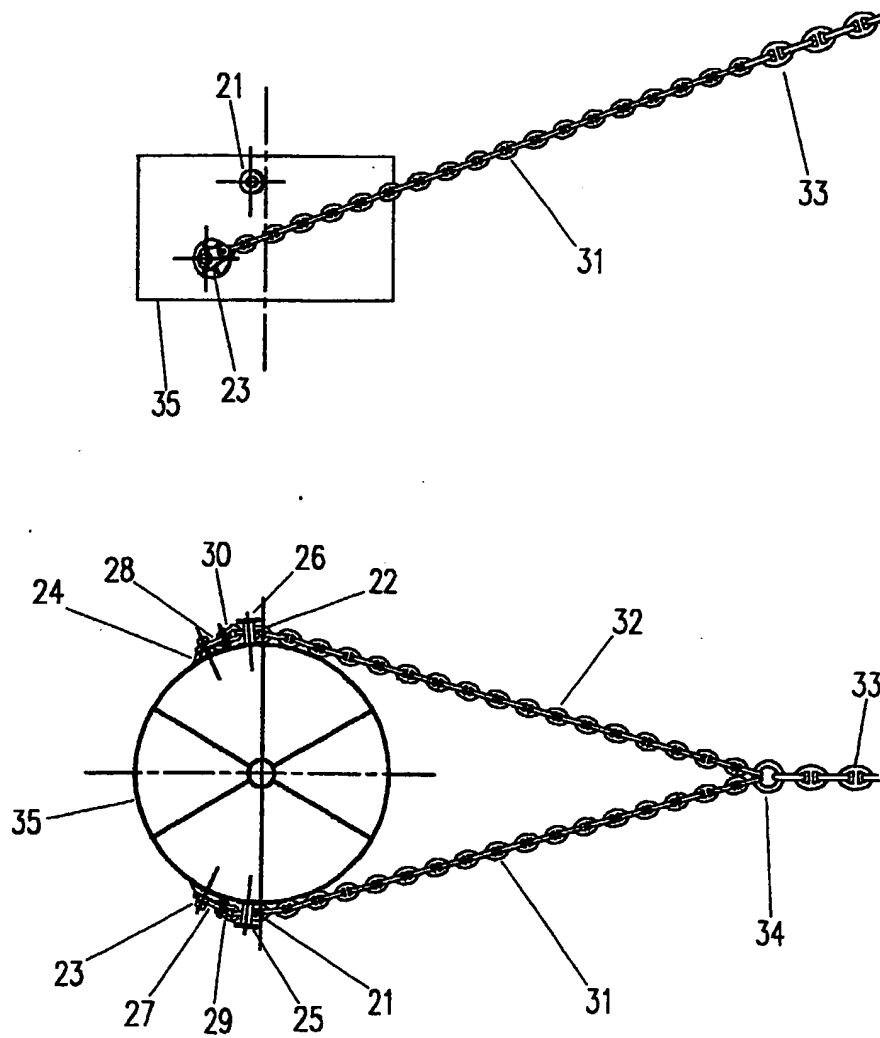


FIG 5

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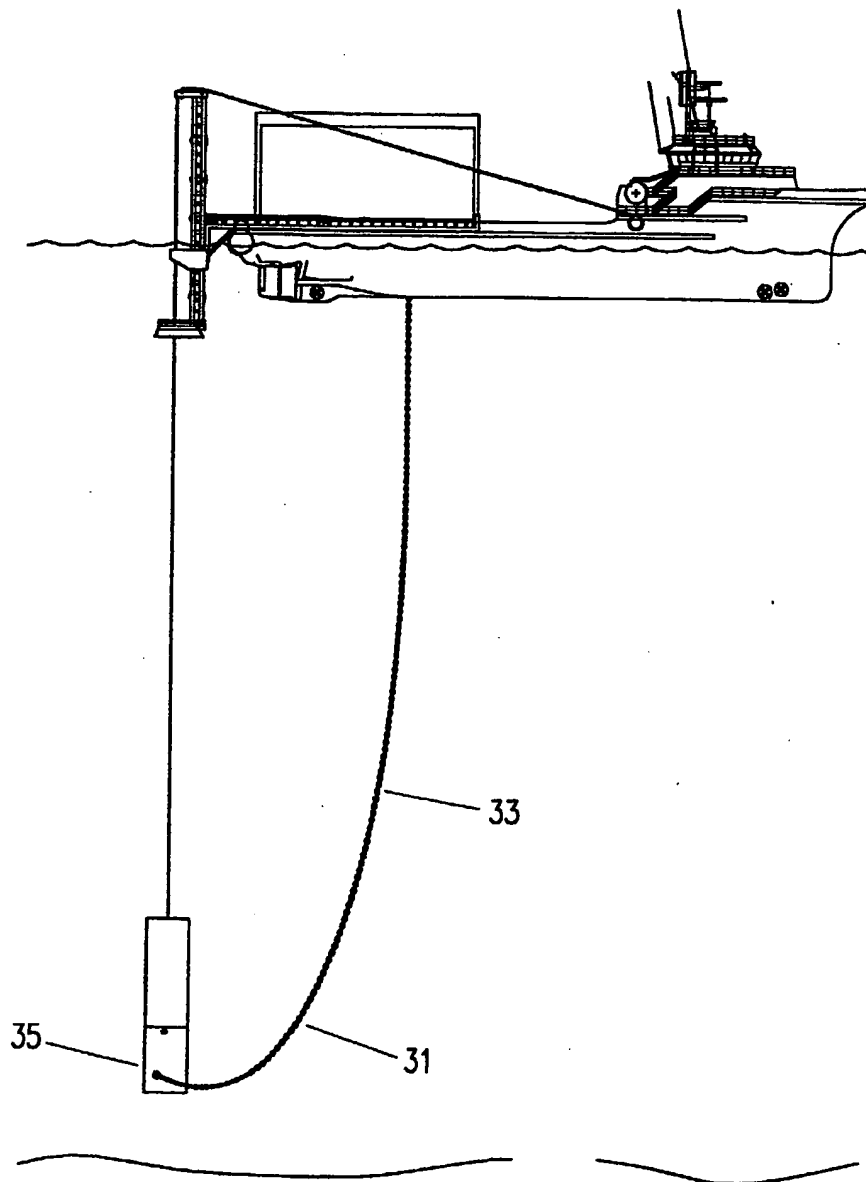


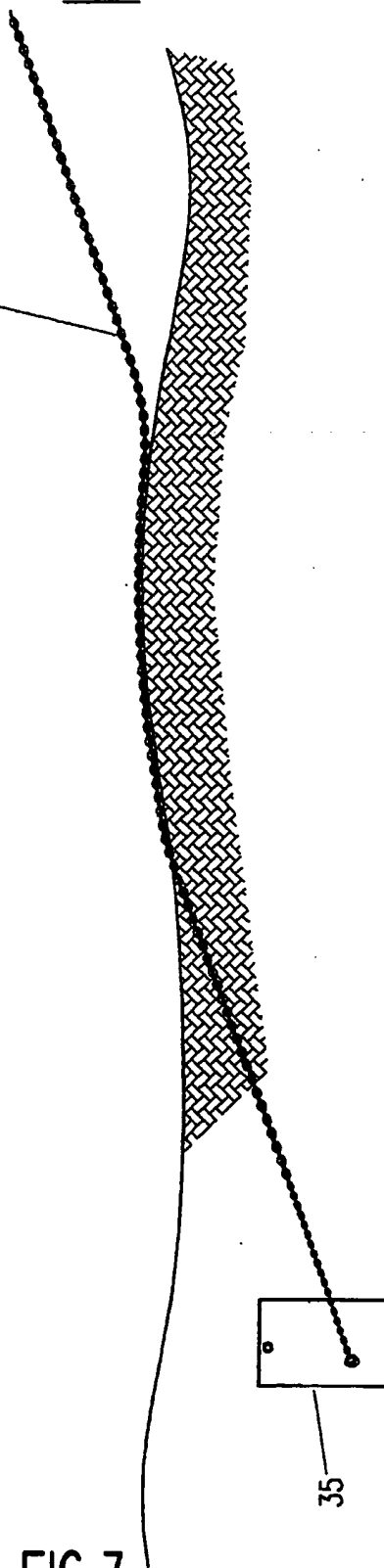
FIG 6

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33

35

FIG 7



0.9
1000

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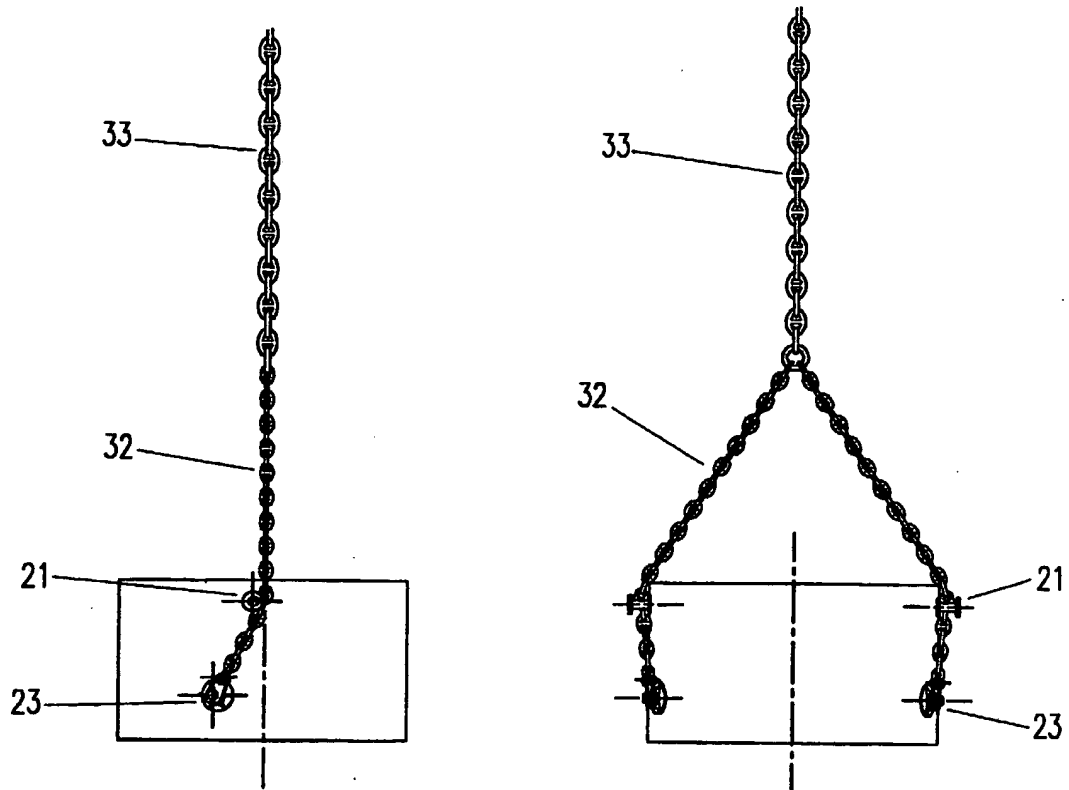


FIG 8

ORIGINAL
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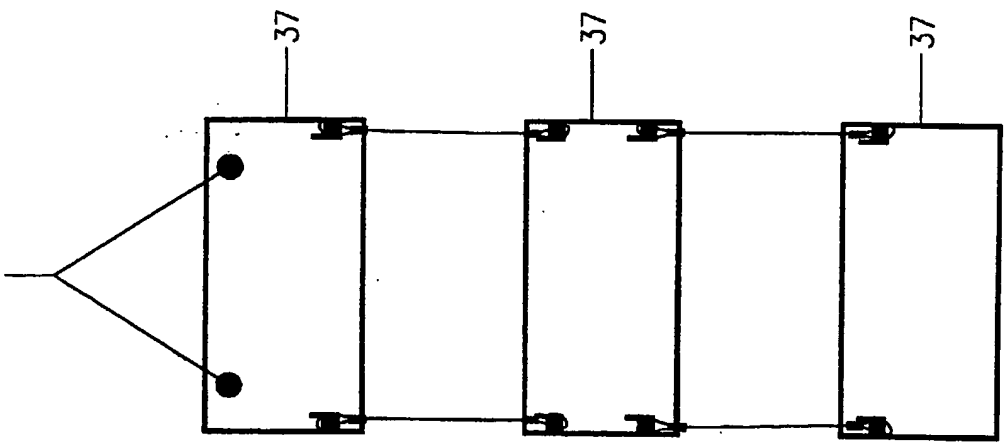


FIG II

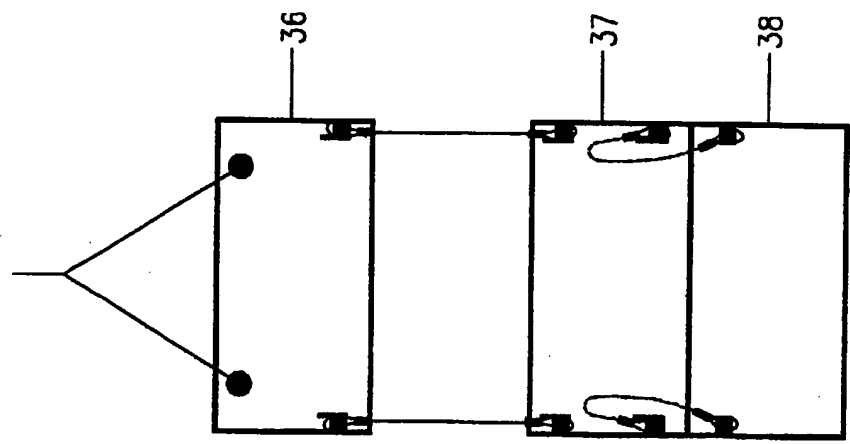


FIG IO

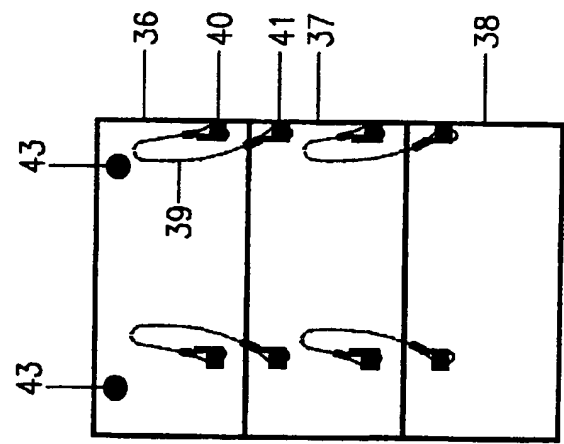
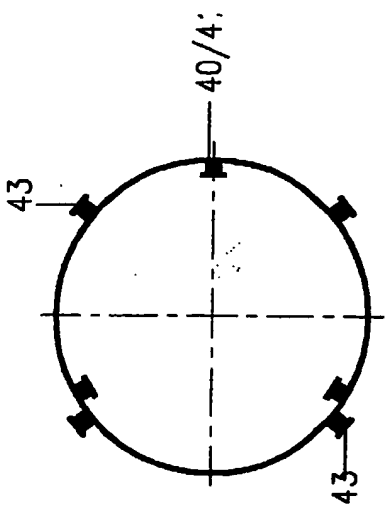


FIG 9

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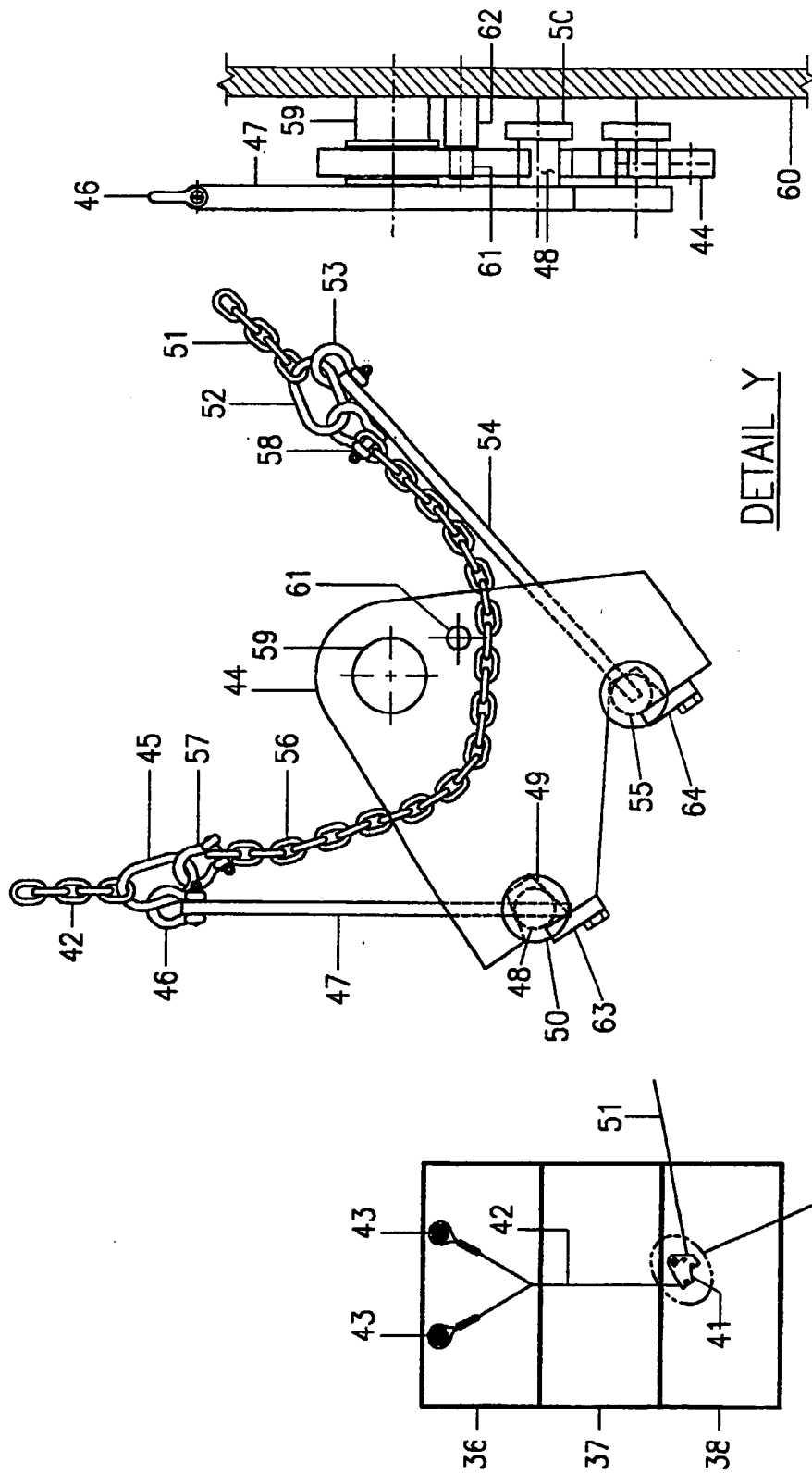


FIG 13

FIG 12

1 **Removable Suction Anchor**

2

3 The invention relates to a removable suction anchor
4 with minimal subsea intervention or without the need
5 for subsea intervention. The invention in its
6 various forms is particularly suited for use with
7 anchors installed by methods other than by drag
8 embedment where the cost of vessel deployment and
9 the retrieval process is usually more than the
10 capital value of the anchors themselves.

11

12 The present invention describes methods of anchor
13 retrieval or abandonment which do not require
14 expensive subsea intervention. They will be useful
15 especially (though not exclusively) in connection
16 with the disconnection and recovery of mooring
17 chains and ropes and rigging from fully buried
18 suction anchors.

19

20 According to a first aspect of the present invention
21 there is provided a subsea suction anchor apparatus
22 which, in use, is anchored in a subsea surface, the
23 suction anchor comprising a plurality of portions
24 which are capable of transformation from a first

1 configuration in which the portions are
2 substantially adjacent one another to a second
3 configuration in which the portions are
4 substantially spaced apart from one another such
5 that the suction anchor is capable of being removed
6 from the subsea surface.

7
8 According to a second aspect of the present
9 invention there is provided a method of removing a
10 subsea suction anchor from a subsea surface, the
11 method comprising providing a plurality of suction
12 anchor portions which are capable of transformation
13 from a first configuration, in which the portions
14 are substantially adjacent one another and in which
15 the suction anchor is capable of being used as a
16 suction anchor, to a second configuration in which
17 the portions are substantially spaced apart from one
18 another, and transforming the suction anchor from
19 the first to the second configuration.

20

21 **Mooring Anchor Disconnection System**

22

23 This is a system of devices and arrangements to
24 enable a mooring line or mooring line bridle to be
25 disconnected from an anchor which is a member of a
26 vessel mooring array when extraction of the anchor
27 is not required or is not possible. The anchor may
28 be a suction anchor with a fully buried lower
29 section or may be a traditional suction anchor or a
30 plate anchor or traditional pile.

31

1 A specific embodiment of the system for use with a
2 suction embedded caisson anchor will now be
3 described by way of an example with reference to the
4 accompanying drawings in which:

5

6 Fig. 1 shows the general arrangement of the
7 invention with an externally mounted spring-
8 loaded pin assembly.

9 Fig. 2 shows an external rigging arrangement.

10 Fig. 3 shows an alternative arrangement in
11 which the spring, taper pin, and stubshaft head
12 are on the inside of the suction anchor can
13 instead of the outside.

14 Fig. 4 shows an internal rigging arrangement.

15

16 The mooring line bridle wire or chain (1) is
17 connected to a rotating padeye unit (2) by a shackle
18 (3). The rotating padeye unit (2) is mounted on a
19 stubshaft (4). The stubshaft (4) spans in double
20 shear between two journal blocks (5) and (6). The
21 inner journal block (5) is welded to a doubler plate
22 (7) which in turn is welded to the suction anchor
23 can. The outer journal block (6) is supported on
24 and welded to a steel cylinder or box (8) which is
25 in turn welded to the doubler plate (7). Slightly
26 more than one quarter (90°) of the cylinder or box
27 (8) is cut away or open to allow access of the chain
28 (1) from directions ranging from horizontal to
29 vertical. The stubshaft (4) extends through and
30 projects beyond the outer journal block (6) and
31 terminates in a head (9). The stubshaft (4) is held
32 in position by a tapered pin (10) which passes

1 through the journal block (6) and the stubshaft (4)
2 and the cylinder or box (8) and is in its turn held
3 in position by a shearpin (11). A helical spring
4 (12) is mounted on the stubshaft between the outer
5 journal block (6) and the stubshaft head (9). A
6 retaining ring (13) may be welded to the outer
7 journal block to assist in locating the spring
8 during assembly. The spring (12) is compressed by
9 forcing the stubshaft home with the aid of a
10 hydraulic jack and strongback bearing against
11 tension bolts set temporarily into the tapped holes
12 (14). The stubshaft (4) has a keyway (15) which
13 engages with a key (16) on the outer journal block
14 (6) in order to ensure that the holes in the
15 stubshaft and journal block are properly aligned to
16 accept the tapered pin. The tapered pin (10) is
17 then inserted and the shearpin (11) in its turn is
18 inserted into the tapered pin to hold it in place.
19 The jack can now be released and the bolts removed
20 from the tapped holes. An actuation chain (18) is
21 attached to the head of the tapered pin (10). The
22 actuation chain terminates in a subsea buoy (19) as
23 indicated in Fig. 2. The actuation chain (18) is
24 sufficiently long to enable the buoy (19) to remain
25 well above seabed level after the suction anchor has
26 been installed.

27
28 When the suction anchor has fulfilled its purpose
29 and is to be abandoned, the mooring is disconnected
30 by attaching a winch line from a surface vessel to
31 the actuation chain (18) with the aid of a WROV
32 (Working Remotely Operated Vehicle) and applying a

1 tension which exceeds the shearing load of the
2 shearpin (11) and the friction between the tapered
3 pin and the stubshaft and journal block and thereby
4 extracts the tapered pin (10) allowing the spring to
5 push the stubshaft (4) out from the journal blocks
6 (5) and (6) sufficiently to release the rotating
7 padeye unit (2). The mooring chain and bridle (1)
8 with the shackle (3) and rotating padeye (2) can now
9 be recovered leaving the suction anchor in place.

10

11 An alternative arrangement in which the spring,
12 taper pin, and stubshaft head are on the inside of
13 the suction anchor can instead of the outside is
14 shown in Fig.3.

15

16 **Mooring Line Removal Together with a Caisson or**
17 **Plate Anchor Without Subsea Intervention:**

18 **Method 1**

19

20 This is a system of devices and arrangements to
21 enable a mooring line to be recovered together with
22 its associated caisson anchor or plate anchor which
23 is a member of a vessel mooring array to be
24 extracted from the seabed by vertical tension on the
25 mooring line from a surface recovery vessel when its
26 use as a mooring anchor at the location in question
27 has come to an end.

28

29 A specific embodiment of the system for use with a
30 suction embedded caisson anchor will now be
31 described by way of an example with reference to the
32 accompanying drawings in which:

1
2 Fig. 5 shows the general arrangement of the
3 system.
4 Fig. 6 shows a modular suction anchor being
5 deployed to the seabed with the mooring chain
6 rigged.
7 Fig. 7 shows the suction anchor and mooring
8 chain in normal use.
9 Fig. 8 shows the mooring chain engaging in the
10 upper bosses prior to removal of the anchor.
11
12 Referring to the drawings, a pair of bosses (21) and
13 (22) is attached to the outside of the suction
14 anchor close to its top on opposite meridians
15 perpendicular to the direction of the mooring line
16 when it is in use as such. A second pair of bosses
17 (23) and (24) is attached to the outside of the
18 suction anchor slightly below its mid-height on
19 meridians which are offset from the meridians of the
20 upper bosses in a circumferential direction away
21 from the direction of the mooring line when it is in
22 use as such. The upper bosses (21) and (22) are
23 fitted with widened heads (25) and (26). The lower
24 bosses are fitted with steel rotating padeye plates
25 (27) & (28) and shackles (29) and (30) securing the
26 mooring bridle chains (31) and (32). The bridle
27 chains are connected to the lead chain or rope of
28 the mooring line (33) via a standard master link
29 (34).
30
31 The sequence of operation is shown in Figs. 6, 7 &
32 8. The suction anchor is deployed to the seabed

1 with the mooring line attached to it via the bridle
2 chains. The mooring line leader (chain, wire rope,
3 or polymer rope) hangs from the surface well clear
4 of the suction anchor deployment winch line and on
5 its intended operational azimuth from the suction
6 anchor axis. When the suction anchor has been
7 installed into the seabed, the mooring line leader
8 is buoyed off to await the arrival of the floating
9 unit which is to use the mooring. When the floating
10 unit has arrived and its mooring cable has been run
11 out and connected to the mooring line leader, the
12 mooring cable is tensioned. This brings the bridle
13 into the configuration shown in Fig. 7. This is the
14 operational configuration of the anchor and mooring.

15
16 When the floating unit has completed its task at the
17 location and the mooring cable has been disconnected
18 from the mooring line leader, the leader and anchor
19 are recovered by an anchor handling tug or other
20 suitable vessel. This is done by attaching the
21 vessel winch line to the leader and applying a
22 vertical tension. The configuration of the bridle
23 changes to that shown in Fig. 4. The bridle chains
24 come into contact with the upper bosses. In this
25 way the resultant vertical force is applied on the
26 axis of the suction anchor. Any small deviation of
27 the suction anchor from the vertical during
28 extraction will thus result in an opposing couple
29 formed by the applied force and the vertical soil
30 resistance so that the deviation will be self-
31 righting.

32

1 When the anchor has been extracted it may continue
2 to hang vertically from the mooring line or may tip
3 and hang with its axis horizontal. Its orientation
4 is immaterial to its recovery over the stern roller
5 of the vessel.

6

7 **Mooring Line Removal Together with a Caisson or**
8 **Plate Anchor Without Subsea Intervention: Method 2**

9

10 This version of the invention is a system of devices
11 and arrangements to enable a caisson anchor or plate
12 anchor to be extracted from the seabed without
13 subsea intervention. This is achieved by pulling
14 vertically on the mooring line. The pull forces
15 required are kept within the limits of vessels and
16 winches of limited capacity by arranging for each
17 section or ring of the anchor to be extracted from
18 the seabed one after the other so that the force
19 required to pull out the whole anchor at once is not
20 needed.

21

22 A specific embodiment of the invention for use with
23 a specially configured suction embedded caisson
24 anchor will now be described by way of an example
25 with reference to the accompanying drawings in
26 which:

27 Fig. 9 shows the general arrangement of the
28 invention in elevation and plan.

29 Fig. 10 shows the general arrangement of the
30 invention with the top ring section pulled
31 from the remaining two sections of the anchor.

1 Fig. 11 shows the general arrangement of the
2 invention with the all ring sections
3 separated.

4 Fig. 12 shows the general arrangement of the
5 invention with chains and rotating link plate
6 attached.

7 Fig. 13 shows the detail of the rotating link
8 plate in plan and elevation.

9
10 The rings (36), (37), and (38) of the lower anchor
11 (three rings in this example) have brackets (40) and
12 (41) between which chains (39) are connected. The
13 mooring line bridle is attached to two pairs of
14 trunnions (43) on the upper ring. When the mooring
15 line is pulled vertically, the upper ring (36) is
16 lifted through the soil. The length of the
17 connecting chains (39) between the upper ring (36)
18 and the next ring (37) is selected so that the first
19 ring (36) is clear of the seabed before the chains
20 become taut and the second rings starts to be
21 lifted. Similarly the length of the connecting
22 chains between ring (37) and ring (38) is selected
23 so that ring (37) is clear of the seabed before ring
24 (38) starts to be lifted. In this way only one ring
25 has to be moved at a time and the required tension
26 is very much less than would be the case if all
27 rings were lifted together. This keeps the anchor
28 extraction operation within the winch capacity of a
29 larger number of vessels.

30
31 In order to ensure that the mooring line is
32 effectively attached to the suction anchor at the

1 correct height during its functioning as a mooring,
2 and in order to ensure that there is a pretension
3 between the rings to keep them together when mooring
4 load is applied, the mooring line bridle is rigged
5 to the trunnions (43) in the manner shown in Figs. 4
6 and 5. Each of the chains (42), which are bridled
7 to the trunnions (43) at their upper ends, is
8 attached at its lower end via a master link (45) and
9 shackle (46) to a steel plate strap (47) with a boss
10 (48) at its lower end. The boss (48) fits into a
11 recess (49) in a rotating link plate (44). The
12 link plate rotates on a boss (59) which is welded to
13 the suction anchor wall (60) (if necessary via a
14 double plate). The link plate is initially
15 restrained from rotation by a shear pin (61) on a
16 block (62) which is likewise welded to the suction
17 anchor wall. The mooring line bridle chain (51) is
18 likewise connected via a master link (52) and
19 shackle (53) to a steel plate strap (54) carrying a
20 boss (55) at its lower end. The boss (55) fits into
21 a recess in the plate (44) in the same manner as
22 boss (48). Both bosses have heads (50) to prevent
23 them from sliding laterally from the recesses.
24 There are spring strips (63) and (64) to retain the
25 bosses (48) and (55) in their recesses. These
26 spring strips are designed so as to allow the bosses
27 to be pulled from the recesses when the pull applied
28 to them has the appropriate direction and exceeds a
29 given threshold value. There is a short length of
30 loose chain (56) connected between master links (45)
31 and (52) via shackles (57) and (58).

1 When the suction anchor is installed, the mooring
2 bridle chains (51), which are connected to the
3 mooring leader chain, are vertical at the link
4 plate. However, the tensions applied to the bridle
5 (mainly from the buoy at the top of the leader chain
6 and from soil friction during anchor installation)
7 are insufficient to shear the pin (61). When the
8 mooring leader chain is connected to the main
9 mooring line of the vessel to be moored and the
10 vessel winches in the catenary line, the angle of
11 departure of the bridle moves progressively from the
12 vertical as the tension increases. When the mooring
13 line has reached its operational configuration, the
14 departure slope of the bridle at the link plate is
15 relatively flat (typically 15° to 30° depending on
16 the mooring tension and the seabed soil type). As
17 the mooring tension increases, the shear pin fails
18 and the link plate is free to rotate slightly,
19 though further rotation is prevented by the chain
20 (42) attached to the trunnions (43). The greater
21 the mooring tension, the greater the tension in the
22 chains (42) and hence the greater the pre-tension
23 between the suction anchor rings holding them firmly
24 together and making them act as a unit
25 notwithstanding that they are not welded together.
26 The rings are prevented from horizontal sliding
27 relative to each other by the joint arrangements
28 described in the patent applications referred to
29 above.
30
31 When the moored vessel has completed its task on
32 station and the mooring line has been disconnected

1 from the leader chain, the bridle (51) returns to
2 the vertical at the link plate (44). Since the pin
3 (61) has by now been sheared, any vertical tension
4 on the bridle chain (51) causes the link plate (44)
5 to rotate and increasing tension causes the boss
6 (55) to be pulled from its recess. The short chain
7 (56) then becomes taut and pulls the boss (48) in
8 its turn from its recess. The bridle chains (51)
9 are now directly connected to the trunnions (43) on
10 the top ring (36) by the chains (42). Further
11 winching in and tension on the line thereafter
12 results in the ring extraction sequence shown in
13 Figs. 9, 10, and 11.

14
15 Thus, there is a system of devices described herein
16 which provide an arrangement of devices and rigging
17 enabling a mooring line and bridle to be recovered
18 from or with a cylindrical, plate or other form of
19 anchor after use. Furthermore, an arrangement of
20 devices and rigging is described which enables a
21 mooring bridle chain to be detached from an
22 abandoned cylindrical anchor caisson by the
23 application of vertical tension to an actuation
24 chain. Also, the actuation chain may be buoyed off
25 subsea or at sea level. Furthermore, the tension
26 may be applied to the actuation chain by a winch
27 line from a surface vessel, the winch line being
28 attached to the actuation chain by WROV or by diver
29 or at the surface.

30
31 In addition, the tension on the actuation chain may
32 shear a shear pin allowing extraction of a tapered

1 retaining pin thus releasing a spring-loaded
2 stubshaft which withdraws through a journal block
3 and thereby in turn causes the release of the
4 rotating padeye termination of a bridle chain.
5 Furthermore, the device may be attached either to
6 the outside or to the inside of an anchor caisson.
7 Also, the spring-loaded stubshaft holding the bridle
8 chain termination may be inserted with the aid of a
9 hydraulic jack and locked by insertion of a tapered
10 retaining pin prior to anchor deployment.

11
12 Furthermore, bosses on the outside of a cylindrical
13 anchor caisson are also described which may enable
14 the caisson to be extracted from the seabed by the
15 application of vertical tension via the mooring
16 chain leader line, mooring chain, and mooring bridle
17 chain.

18 In addition, the upper bosses may be on opposite
19 sides of the caisson close to its top and both
20 slightly offset in the same direction from the
21 transverse diametral meridian while the lower bosses
22 likewise on opposite sides are still further offset
23 both in the same direction from the plane of the
24 upper bosses. Also, the vertical tension may be
25 applied to the mooring chain leader line by the
26 winch line of a surface vessel. Also, the mooring
27 bridle chains may be attached to the lower bosses on
28 either side of an anchor caisson. Furthermore, the
29 upward tension on the mooring line typically brings
30 the bridle chains into contact with the upper bosses
31 thereby encouraging the vertical axis of the caisson
32 to remain close to vertical during extraction from

1 the seabed as a result of the fact that rotation due
2 to the vertical soil resistance to extraction
3 automatically generates a restoring couple.

4
5 There is also described an arrangement of devices
6 and rigging which may consist of an anchor caisson
7 made up of two or more cylindrical ring sections on
8 top of each other and rigged in such a manner as to
9 enable the anchor ring sections to be extracted
10 sequentially from the seabed by the application of a
11 vertical tension to the mooring line. Furthermore,
12 each ring section may be connected to the next
13 section above or below it by chains attached
14 internally at 120° intervals around the
15 circumference. Also, the mooring bridle chains may
16 be attached to link plates on opposite sides of the
17 lowest ring section, the connection of each chain to
18 its link plate being via a straight steel strap with
19 a boss on one side close to the end and this boss
20 locating into a recess in the edge of the link plate
21 and being retained by a spring-loaded retainer bar.
22 Furthermore, each delta plate may be mounted on a
23 trunnion so that it is free to rotate subject to the
24 shearing of a shear pin. Also, there are typically
25 four bosses at suitable circumferential intervals on
26 the outside near the top of the upper ring section
27 and wherein bridle chains are attached to these
28 bosses via rotating padeyes, one bridle being
29 located on each side of the caisson and with the
30 bridle apex connected via a vertical link chain to
31 the link plate on the lowest ring section with the
32 aid of straps, bosses, and recesses similar to those

1 connecting the mooring bridle chains to the link
2 plates. In addition, there may be a short length of
3 slightly slack connecting chain between the
4 chain/strap junctions on the bridle chains and link
5 chains at each link plate. Also, any significant
6 tension on the mooring line in its operational
7 orientation may cause the shearing of the shear pins
8 followed by a small rotation of the link plates and
9 a tensioning of the link chains thus holding the
10 several ring sections of the anchor more firmly
11 together the greater the pull on the mooring.
12 Furthermore, a vertical tension on the mooring line
13 after shearing of the shear pins typically results
14 in free rotation of the link plates towards the link
15 chains followed by escape of the strap bosses from
16 their recesses under the influence of tensions which
17 exceed the retaining capacity of the spring-loaded
18 retainer bars and are now acting in directions which
19 cause escape rather than bedding down. Furthermore,
20 further vertical tension on the mooring line
21 typically causes the rigging to reorientate so that
22 the mooring line now pulls upwards on the four
23 bosses on the upper ring section via the bridle
24 arrangements thus initiating extraction of the upper
25 ring section from the seabed. In addition, the
26 internal chains connecting the ring sections are
27 typically of such lengths that the upper ring
28 section is clear of the soil before tension is
29 applied to the second and the second is clear of the
30 soil before tension is applied to the third and so
31 forth thus ensuring that the required tension at any

- 1 time is limited to that needed for the extraction of
- 2 one ring section.

1 **Claims**

2

3 1. A subsea suction anchor apparatus which, in
4 use, is anchored in a subsea surface, the suction
5 anchor comprising a plurality of portions which are
6 capable of transformation from a first configuration
7 in which the portions are substantially adjacent one
8 another to a second configuration in which the
9 portions are substantially spaced apart from one
10 another such that the suction anchor is capable of
11 being removed from the subsea surface.

12

13 2. A subsea suction anchor apparatus according to
14 claim 1, wherein the suction anchor comprises a
15 substantially cylindrical body having a longitudinal
16 axis, and the portions comprise discrete
17 longitudinal lengths of the body.

18

19 3. A subsea suction anchor apparatus according to
20 claim 2, wherein the portions of the suction anchor
21 are coupled to one another such that when the
22 suction anchor is in the first configuration, each
23 portion is coincident with the other portions when
24 the suction anchor is in use as a suction anchor,
25 and each portion is adjacent to the closest other
26 portion.

27

28 4. A subsea suction anchor apparatus according to
29 any of claims 1 to 3, wherein the portions of the
30 suction anchor are coupled to one another by a
31 coupling means, such that when the suction anchor is
32 in the second configuration, the coupling means

1 permits the portions to be spaced apart from one
2 another, such that the suction anchor may be removed
3 from the subsea surface.

4
5 5. A subsea suction anchor apparatus according to
6 any of claims 1 to 4, wherein an actuation means is
7 provided such that operation of the actuation means
8 permits the transformation of the suction anchor
9 from the first to the second configuration.

10
11 6. A subsea suction anchor apparatus according to
12 claim 5, wherein the actuation means comprises a
13 releasable locking means which is coupled to an
14 actuation line, such that an applied force to the
15 actuation line permits release of the locking means.

16
17 7. A method of removing a subsea suction anchor
18 from a subsea surface, the method comprising
19 providing a plurality of suction anchor portions
20 which are capable of transformation from a first
21 configuration, in which the portions are
22 substantially adjacent one another and in which the
23 suction anchor is capable of being used as a suction
24 anchor, to a second configuration in which the
25 portions are substantially spaced apart from one
26 another, and transforming the suction anchor from
27 the first to the second configuration such that the
28 suction anchor is capable of being removed from the
29 subsea surface.

30
31 8. A method according to claim 7, wherein the
32 suction anchor comprises a substantially cylindrical

1 body having a longitudinal axis, and the portions
2 comprise discrete longitudinal lengths of the body.

3
4 9. A method according to claim 8, wherein the
5 portions of the suction anchor are coupled to one
6 another such that when the suction anchor is in the
7 first configuration, each portion is coincident with
8 the other portions when the suction anchor is in use
9 as a suction anchor, and each portion is adjacent to
10 the closest other portion.

11
12 10. A method according to any of claims 7 to 9,
13 wherein the portions of the suction anchor are
14 coupled to one another by a coupling means, such
15 that when the suction anchor is in the second
16 configuration, the coupling means permits the
17 portions to be spaced apart from one another, such
18 that the suction anchor may be removed from the
19 subsea surface.

20
21 11. A method according to any of claims 7 to 10,
22 wherein an actuation means is provided such that
23 operation of the actuation means permits the
24 transformation of the suction anchor from the first
25 to the second configuration.

26
27 12. A subsea suction anchor apparatus according to
28 claim 11, wherein the actuation means comprises a
29 releasable locking means which is coupled to an
30 actuation line, such that an applied force to the
31 actuation line permits release of the locking means.

32

- 1 13. Apparatus as hereinbefore described with
2 reference to Figs. 9 to 13 of the drawings.
3
- 4 14. A method as hereinbefore described with
5 reference to Figs. 9 to 13 of the drawings.



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Claims searched: 1 to 14

Examiner: Richard Collins
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Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:
UK Cl (Ed.T): B7V VHG.
Int Cl (Ed.7): B63B 21/22, 21/24.
Other: Online EPODOC, JAPIO, WPI.

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2317153 A (KARAL) see figures 9 to 13 and related description.	-

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.